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ORIGINAL RESEARCH

Myopia: An Increasing Problem for Medical Students at the University of Gondar

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Purpose: The purpose of this study was to assess the prevalence and associated factors of myopia among medical students at the University of Gondar College of Medicine and Health Sciences, Northwest Ethiopia.

Patients and Methods: Institution-based cross-sectional study was conducted at the University of Gondar College of Medicine and Health Sciences from June 20 to August 15, 2021. A simple random sampling technique with proportional allocation was used to select 492 students. Interviewer-administered questionnaire, Snellen acuity chart, pinhole, retinoscope and direct ophthalmoscope were used to collect the data. The data were entered to EpiData version 4.6 and exported to SPSS version 25 for analysis. Descriptive statistics were summarized by measures of central tendency. Variables with p-value ≤0.2 in bivariable regression were entered into a multivariable logistic regression model. Adjusted odds ratio with 95% confidence interval was used and variables with p-values <0.05 were considered as statistically significant.

Results: A total of 492 respondents participated giving a response rate of 98.3%. The prevalence of myopia was found to be 16.7% (95% CI = 12.8–19.4%). Urban residents (AOR = 1.56; 95% CI: 1.28–6.21), family history of myopia (AOR = 2.31; 95% CI: 1.33–4.54), near-work activity of 5–7 hours (AOR = 2.41; 95% CI: 1.31–5.76) and ≥8 hours (AOR = 4.35; 95% CI: 1.96–9.66), outdoor activity for <3 hours (AOR = 1.65 95% CI: (1.14–4.53), were significantly associated with myopia.

Conclusion: The prevalence of myopia among medical students at the University of Gondar College of Medicine and Health Sciences was high. Urban residency, positive family history, longer time spent on near-work activities and less outdoor activity were positively associated with myopia.

Keywords: myopia, medical students, Gondar, Ethiopia

Introduction

Myopia is a common cause of correctable visual reduction and is the leading cause of visual impairment globally. The main clinical presentations of myopia include reduction of distance and/or near vision, reduction of color vision, diminished contrast sensitivity, constriction of visual field, fear of light and loss of vision.[1]

The prevalence of myopia has been shown to vary widely with geographic location.[2] Globally, the prevalence of myopia was estimated to be 34% by 2020 and it is estimated that 50% of the global population will be myopic by 2050.[3 4] A study done in East Asia showed a prevalence of myopia exceeding 70%.[5] Age-specific prevalence of myopia from age 20–29 years in Asia and Europe is reported as 45−50% and 20–35%, respectively.[6,7] Its prevalence and distribution in Africa is lower than Asian and European countries.[8] The prevalence of myopia in East Africa was 4.2% in 2010 and projected to be 8.2%, 12.3% and 22.7% by the years 2020, 2030 and 2050, respectively.[9]

Myopia has been associated with complications, such as myopic macular degeneration (MMD), retinal detachment (RD), cataract, and open angle glaucoma (OAG).[10] These complications can lead to irreversible visual impairment later in life.[11]

The rapid increase in the prevalence of myopia has huge social, educational and economic consequences to the society.[12] Uncorrected myopia was estimated to cause $244 billion potential productivity loss worldwide and macular

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degeneration due to myopia alone was associated with another $6 billion potential productivity loss annually.[13] Myopia has also a great impact on career choices, ocular health, learning capability, educational potential and quality of life.[14,15]

Evidence suggests that both genetic and environmental factors affect myopia.[16] According to available evidence excessive near-work, little outdoor activity, positive family history of myopia, joining higher education, increased use of computers and electronic devices are the major risk factors for myopia development.[17–19]

A variety of clinical methods are currently utilized for prevention and management of myopia. The possible alternatives to treat myopia are spectacles, contact lenses, medications such as atropine, phenylephrine, increasing time spent outdoors, reducing near-work intensity, proper diet and study breaks.[20]

Although there are some community and school-based myopia studies on pre-school and school children, there is no published information about prevalence and associated factors of myopia among medical students in Ethiopia specifically in the study area. Therefore, the purpose of this study was to assess the prevalence of myopia and its associated risk factors among medical students at the University of Gondar, College of Medicine and Health Sciences (CMHS).

Methods and Materials

Study Area, Design and Period

An institution-based cross-sectional study was conducted at the University of Gondar, College of Medicine and Health sciences from June 20, 2021 to August 15, 2021.

Source and Study Population

All medical students at the University of Gondar, College of Medicine and Health Sciences were the source population for this study.

Inclusion Criteria

All medical students at University Gondar, College of Medicine and Health Science during the data collection period.

Exclusion Criteria

Students who had active ocular infection, previous intra-ocular surgery and media opacity were excluded from the study.

Sample Size Determination

The required sample size was determined using a single population proportion formula. By taking the prevalence of myopia (11.9%) from a study conducted on high school students in Gondar city,[14] margin of error 3%, z statistic at 95% confidence interval 1.96 and 10% non-response rate, the final sample was determined to be 492.

Sampling Technique and Procedure

A simple random sampling technique was used to recruit 492 study participants. The total number of medical students at the University of Gondar, College of Medicine and Health Sciences was 943. The sample was proportionally allocated to the year of study of students and simple random sampling was used to select participating students (Figure 1).

Variables of the Study

Dependent Variable

Myopia (yes or no).

Independent Variables

Socio-demographic factors (age, sex, year of study, residence).

Environmental and educational factors (time spent on near-work, working distance, illumination during study, reading hours, time spent outdoors, using visual display unit, staying up late, break during study).

Family-related factors (positive family history of myopia, family educational status, family income).

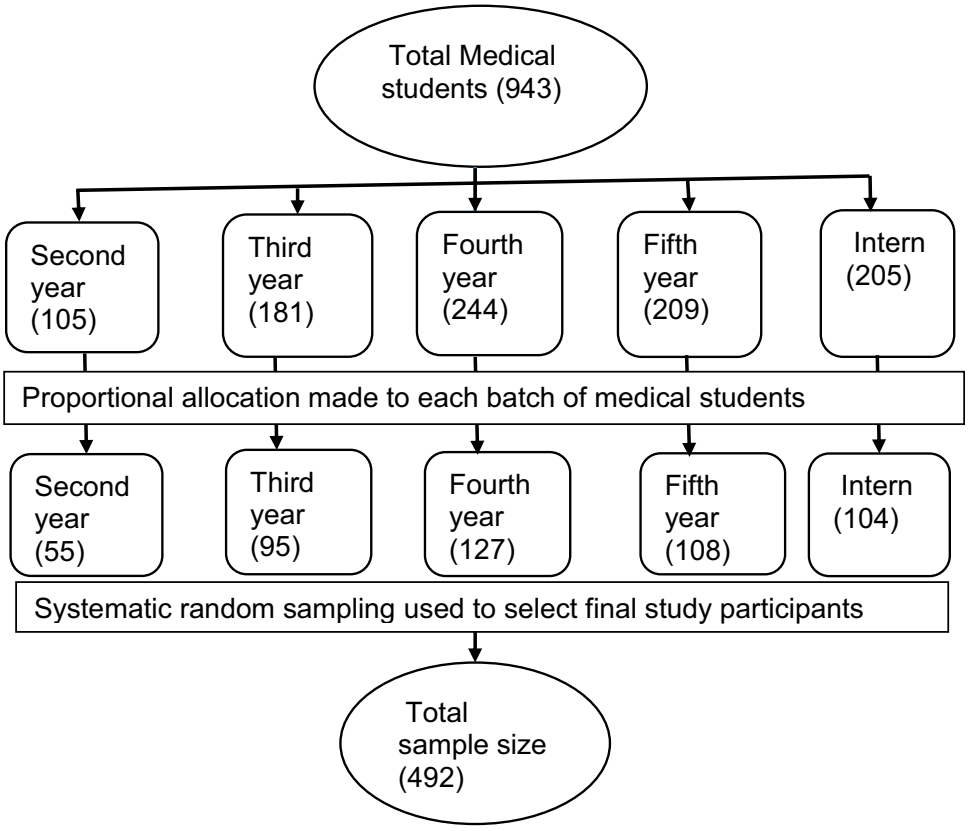

Figure 1 Flow chart showing sampling procedures sampling technique and how proportional allocation was made among different batches of University of Gondar Medical students in 2021.

Operational Definition

Myopia was defined as a spherical equivalent refractive error (SER = sphere + 1/2 cylinder) of ≤−0.50 D.

Degree of myopia: Myopia is considered as low myopia when it is −0.50 D to −3.00 D, moderate myopia when it is < −3.00 D to −6.00 D and high myopia when it is <−6.00 D.

Familial myopia: First degree relatives (father, mother, brother and sister) with any degree of myopia previously diagnosed by a professional.

Ocular abnormality: Any ocular disorder such as keratoconus, strabismus, ptosis, corneal opacity, cataract, lens subluxation or dislocation.

Outdoor activity: Activities such as walking, playing football outside, per day.

Working distance: The regular distance in centimeters at which a person adapts to do near tasks. The average working distance for a normal individual is 33 cm.

Visual display unit (VDU): A screen-based device that displays text or pictures that reflect data stored in a computer's memory.

Data Collection Procedures and Personnel

English version structured questionnaire was prepared by reviewing different studies.[14,21–26] Interview and ocular examination were conducted for study participants by five trained optometrists. Three-meter Snellen acuity chart, pinhole, streak retinoscope and direct ophthalmoscope were used for ocular examination of the students. Non-cycloplegic refraction was done for study participants to screen for myopia.

At the end of the examination, study participants were told and advised about their visual status and eye conditions. Participants with conditions were linked to the optometry department for further treatment and follow-up.

Data Quality Assurance

The quality of data was assured through different strategies. Pretest (5%) was conducted on 5% of the total sample size among medical students of Debre-Tabor University, College of Medicine and Health Sciences before the actual data collection time. Based on the pretest some modifications were done on unclear questions, concept and sequences of the question before applying it to the actual study participants. Data collectors and supervisors were trained for a half-day about the data collection. Respondents were oriented about the objective of the study on the data collection day. In addition, 5% of the data was cross checked for completeness at the end of each data collection day. The data were further cleaned and coded after data entry.

Data Processing and Analysis

The collected data were entered into EpiData version 4.6 and exported to SPSS version 25 statistical software for analysis.

The outcome variable was dichotomized and coded as "0" and "1", representing those who do not have or have myopia, respectively. Statistics were described using frequencies, mean and standard deviation and presented by tables, figures, and text.

Binary logistic regression analysis was carried out to identify factors associated with myopia. Those variables with $p \leq 0.2$ from bivariable analysis was entered to multivariable logistic regression model to control the possible effects of confounder/s, and then variables with a p-value of ≤ 0.05 in multivariable logistic regression model was considered statistically significant. Before conducting the multivariable logistic regression, model multicollinearity was checked using variable inflation factor (VIF). Hosmer and Lemeshow goodness of fit was computed and the model was adequate with a p value of 0.32. Adjusted odds ratio with 95% confidence interval was computed to see the presence, strength and direction of association between dependent and independent variables.

Ethical Considerations

The study was conducted according to the Declaration and tenets of Helsinki. Ethical clearance was obtained from University of Gondar, College of Medicine and Health Sciences, School of Medicine Ethical Review Committee. Written informed consent was obtained from each study participant after explaining the purpose of the study. Participants were given a full right to participate, refuse or withdraw from the study at any time they wanted. Confidentiality was maintained and assured by excluding their names from the questionnaire, coding and locking the data.

Students with myopic and other ocular conditions were linked to the optometry department for treatment and follow-up. All study participants were advised about the importance of regular ocular screening even in the absence of any visual symptoms or problems.

Result

Socio Demographic and Economic Characteristics of Participants

A total of 484 medical students participated in this study with a response rate of 98.3%. The mean age of the participants was 22.81 ± 2.11 (SD). From all participants, 234 (46.5) were between age group of 21–23 years, 63.1% were previously urban residents, 307 (63.4%) were male and 361 (74.6%) were orthodox followers. Regarding year of study, the largest proportion of participants (126; 26%) were fourth year students. Most of the participants (258; 53.3%) had parents with an educational status of college and above. There were 142 (29.3%) students who had at least one positive family history. The median family monthly income of the respondents was 7000 (IQR = 4000) Ethiopian Birr (ETB) (Table 1).

Environmental Characteristics and Family-Related Myopia

The mean working distance was 45.86 cm ±4.97 (SD). Out of 484 participants, 148 (30.6%) had working distance between 42–46 cm; 246 (50.8%) students were not taking a break after 1 hour reading, and had a habit of staying up late after 12 AM (midnight); and 271 (56.8) of the participants use a fluorescent or lamp while reading.

Table 1 Socio Demographic and Economic Characteristics of Medical Students at University of Gondar College of Medicine and Health Sciences, Northwest Ethiopia, 2021

Variable	Frequency	Percentage
Age (years)		
≤20	50	12.2
21–23	234	46.5
>23	200	41.3
Sex		
Male	307	63.4
Female	177	36.6
Year of study		
2nd	53	11.0
3rd	93	19.2
4th	126	26.0
5th	108	22.3
6th (intern)	104	21.5
Religion		
Orthodox Christian	361	74.6
Muslim	70	14.5
Protestant	41	8.5
Catholic/Adventist	12	2.5
Area of residence before joining medical school		
Urban	361	74.6
Rural	123	25.4
Average family monthly income ETB		
≤6000	148	30.6
6001–8000	112	23.1
8001–10,000	111	22.9
>10,000	113	23.3
Parental education status		
Non-formal education	86	17.8
Primary school	51	10.5
Secondary school	89	18.4
College/university	258	53.3
Occupation of parents		
Farmer	80	16.5
Merchant	118	24.38
Government employed	109	22.5
Private employed	169	23.9
Others[a]	8	1.65

Notes: n = 484. [a]Priest, home duties and retired.

About 128 (26.4%) of students spent more than 7 hours per day and 171 (35%) students spent more than 5 hours per day on near-work and visual display unit, respectively. In addition, more than two-thirds (86%) of participants were not reading under dim light; 312 (64.5%) students had less than 3 hours per day outdoor activity; and 142 (29.3%) participants had a positive family history of myopia (Table 2).

Table 2 Environmental Characteristics and Family Related Myopia of Medical Students at the University of Gondar, College of Medicine and Health Sciences, Northwest Ethiopia, 2021

	Frequency	Percent
Habitual Working distance		
≤41 cm	100	20.7
42–46 cm	148	30.6
47–50 cm	134	27.7
>50 cm	102	21.1
Study break after 1 hour reading		
Yes	238	49.2
No	246	50.8
Do you use fluorescent or lamp (60–100 Watt) while reading		
Yes	271	56.0
No	213	44.0
Habit Staying up late after 12 AM (midnight)		
Yes	312	64.5
No	172	35.5
Near-work activity per day		
≤4 hours	158	32.6
>4–5 hours	105	21.7
>5-7 hours	93	19.2
>7 hours	128	26.4
When started using computer, tablet or cell phone		
Primary	49	21
Secondary	221	47
University/college	183	12
VDU use per day		
≤5 hours	313	64.7
>5 hours	171	35.3
Reading under dim light		
Yes	68	14
No	416	86
Average indoor activity per day		
<3 hours	161	33.3
3–5 hours	246	50.8
>5 hours	77	15.9
Outdoor activity per day		
≤3 hours	312	64.5
>3 hours	172	35.5
Familial myopia		
Yes	142	29.3
No	342	70.7
Ocular abnormality		
Yes	23	4.76
No	461	95.24

Note: n = 484.

Prevalence of Myopia Among Medical Students

The overall prevalence of myopia among medical students at the University of Gondar, College of Medicine and Health Sciences was found to be 16.7% (95% CI: 12.8–19.2%). Considering the degree of myopia, 63 (77.7%) had low myopia, 16 (19.8%) had moderate myopia and 2 (2.5) had high myopia.

Factors Associated with Myopia

Bivariable logistic regression analysis was done with the variables age, sex, year of study, residence before joining university, time spent on near-work, working distance, illumination during study, reading hours, time spent outdoors, using a visual display unit, staying up late, break during reading, positive family history of myopia, family educational status and average family income and variables with p value of <0.2 were selected for multivariable analysis. Age, sex, area of residence before joining university, average family income, positive family history, working distance, study break after 1 hour reading, staying up late, excessive near-work and less outdoor activity were all revealed to be significant in bivariable logistic regression analysis. However, on multivariable logistic regression analysis, area of residence before joining university, family history of myopia, excessive near-work and less outdoor activity remained statistically significant factors for development of myopia.

Accordingly, the odds of being myopic among participants who were previously urban residents were 1.56 times (AOR=1.58; 95% CI: 1.28, 6.21) compared with those who were rural residents. The odds of developing myopia among medical students who had positive family history of myopia were 2.31 times (AOR = 2.31; 95% CI: 1.33–4.14) higher than students who had no positive family history of myopia.

Regarding near-work of participants, the odds of being myopic among participants who had spent >5–7 hours per day and >7 hours per day were 2.41 times (AOR = 2.41; 95% CI: 1.31–5.76) and 4.35 times (AOR = 4.35; 95% CI: 1.96–9.66) high chance of developing myopia respectively compared with those who had spent ≤4 hours on near-work. Students who spent <3 hours on outdoor activity per day were 1.65 times (AOR = 1.65; 95% CI: (1.14–4.60) more likely to develop myopia compared with students who spent ≥3 hours on outdoor activity per day (Table 3).

Discussion

The prevalence of myopia among medical students at the University of Gondar College of Medicine and Health Sciences, Northwest Ethiopia was found to be 16.7% (95% CI: 12.8–19.2). The prevalence in the current study was not in line with any previous figures reported among medical students. Nevertheless, it was consistent with studies conducted in Norway among adolescent age groups (13%)[27] and Jordan among school-age children (17.6%).[28]

Compared with other school-based studies previously done in Gondar 11.9%,[14] Bahir Dar8.49%,[22] Welkite 6.5%,[29] Nigeria 7.5%[30] and South Africa 5%,[31] the reported prevalence in the present study was higher. The variation might be due to the differences in the extent of exposure to risk factors of myopia. Medical students spend most of their time on reading and near-work activities in addition to limited outdoor activity which might have contributed to a higher prevalence of myopia compared with these schoolchildren.

The overall prevalence of myopia in the present study was lower than found in a study done in Nigeria among medical students (68.4%).[32] Differences in inclusion criteria might be responsible for the observed difference. The study subjects in the Nigerian study were only spectacle wearers. Patients with refractive errors such as myopia are more likely to wear spectacles which may increase the reported prevalence of myopia. The prevalence was also found to be lower compared with reports from similar studies conducted in Aljouf Saudi Arabia 53.5%,[33] Qassim 53.7%,[21] Iran 42.71%,[34] Mongolia China 69.21%,[26] Northern China 78.5%,[28] Lahore India 57.6%,[35] Singapore 78.5%,[36] Maharashtra, India 58.83%,[37] Rajasthan, India 52.79%,[38] Karachi, Pakistan 57.65[23] and Vietnam 20.4%.[39] This might be because of the difference in sample size, study setting and socio-demographic characteristics and type of screening tools used.

Studies done in Iran,[34] Mongolia China[26] and Northern China[36] were based on a larger sample size. As these studies are from Asian countries where myopia is highly prevalent even in the general population, the increased prevalence of myopia among medical students in these countries might be due to the effects of complex genetic traits favoring

Table 3 Bivariable and Multivariable Logistic Regression Analysis for Factors of Myopia Among Medical Students at the University of Gondar, College of Medicine Health Sciences, Northwest Ethiopia, 2021

Variables	Myopia				P value
	Yes	No	COR (95% CI)	AOR (95% CI)	
Sex					0.070
Male	37	270	1.00	1.00	
Female	44	133	2.41(1.28,3.91)	1.35(0.88,4.78)	
Age (years)					0.210
≤20	13	50	1.00		
21–23	38	234	1.17(0.59,2.33)	1.31(0.82,7.61)	
>23	30	200	0.98(0.68,1.99)	0.91(0.56.2.37)	
Area of residence before joining university					0.040
Urban	64	289	1.48(1.34,5.76)	1.56(1.28,6.21) *	
Rural	17	114	1		
Average Family income (ETB)					0.170
≤6000	14	148	1.00		
6001–8000	20	112	1.88(1.23,4.32)	1.30(0.50,3.38)	
8001–10,000	18	105	1.81(0.87,3.903)	1.51(0.56,4.05)	
>10,000	29	119	2.57(1.15,6.61)	2.15(0.86,5.38)	
Family history of myopia					0.005
Yes	37	105	2.38(1.46,3.89)	2.31(1.33,4.54) *	
No	44	298	1.00	1.00	
Working distance					0.230
≤41 cm	20	80	1.72(1.12,3.66)	1.42(0.60,3.32)	
42–46 cm	27	121	1.52(0.74,3.12)	1.29(0.58,2.86)	
47–50 cm	21	113	1.27(0.608,2.68)	1.15(0.56,2.36)	
≥51 cm	13	89	1.00		
Study break after 1 hour reading					0.080
Yes	43	196	1.00		
No	38	207	1.07(0.63,1.418)	0.76(0.45,1.31)	
Staying up late					0.430
After midnight	64	248	2.35(1.32,4.16)	1.24(0.66,1,33)	
Before midnight	17	155	1.00		
Near-work activity per day					<0.001
≤ 4 hours	12	148	1.00		
>4 −5 hours	15	93	1.98(0.87,4.59)	1.46(0.62,3.94)	
>5-7 hours	21	74	3.50(1.6,6.58)	2.41(1.31,5.76)*	
>7 hours	33	88	4.8(3.2,14.12)	4.35(1.96,9.66)**	
VDU use per day					0.076
≤5 hours	36	277	1		
>5 hours	45	126	2.75(1.27,4.46)	2.24(0.89,3.92)	
Outdoor activity per day					0.005
<3 hours	52	194	1.93(1.44,4.60)	1.65(1.16,6.60)*	
≥3 hours	29	209	1		

Notes: n = 484. *p <0.05, **p <0.001.
Abbreviations: ETB, Ethiopian Birr; COR, Crude odds ratio; AOR, Adjusted odds ratio; VDU, Video Display Unit; AM, Ante meridian.

myopia.[40] Additionally, high utilization of digital devices which increases near-work involvement might be the reason for higher prevalence of myopia in the above studies.

In the present study it was found that students who were urban residents before joining medical school were 1.56 times more likely to develop myopia compared with those who were rural residents. This finding was supported by studies conducted in Asian countries such as Singapore,[7] South Korea,[41] Taiwan,[42] China[43–45] and Israel.[46] The reason for this might be because urban residents spend more time indoors and engaged more on near-work activities.

Medical students who had a positive family history of myopia in at least one person in their family were 2.31 times more likely to develop myopia compared with those who had no family history of myopia. This finding was consistent with other cross-sectional studies conducted in Pakistan,[47] China[26] and India[48] and several school-based studies in Gondar, Bahir Dar[14,22] and China.[49–51] This might be because of the hereditary predisposition of myopia.[52]

This study also discovered that medical students who spent >5–7 hours per day and >7 hours per day on near-work were 2.41 and 4.35 times more likely to develop myopia, respectively, than those who spent ≤4 hours per day. The result was consistent with studies done in Singapore,[35] India,[53] Pakistan,[54] Turkey[55] and Norway.[56] This could be because prolonged near-work causes ciliary spasm which causes a defocused peripheral retinal image. The defocused peripheral retinal image is a stimulus for axial length elongation and progression of myopia.[14]

The odds of being myopic among participants with outdoor activity of ≤3 hours per day were 1.65 times higher compared with those who had >3 hours of outdoor activity per day. In this regard, the finding was similar with other cross-sectional findings previously reported in Norway,[56] Beijing,[57] Indonesia[58] and Turkey.[55] Dopamine, which is obtained from sunlight exposure, inhibits axial elongation and the occurrence of myopia. When outdoor activities are limited, the exposure to sunlight is limited so that the amount of dopamine released will be less leading to less inhibition of axial elongation. This increases the risk of myopia development and progression.[59]

Limitation of the Study

The study was a single center study, the students who participated in this study may not be representative of the overall university medical students with myopia. There may be self-reported bias during completion of the questionnaire on time spent on visual display electronic devices, family history of myopia and family monthly income.

Conclusion

The prevalence of myopia among medical students at the University of Gondar, College of Medicine and Health Sciences was relatively low compared with similar studies done elsewhere in the world. Urban residency, positive family history, longer time spent on near-work activities and less time spent outdoors were the factors significantly associated with myopia among medical students.

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Disclosure

The authors declare that there are no conflicts of interest in this work.

References

1. Wu LJ, You QS, Duan JL, et al. Prevalence and associated factors of myopia in high school students in Beijing. *PLoS One*. 2015;10(3):e0120764.
2. Vitale S, Sperduto RD, Ferris FL. Increased prevalence of myopia in the United States between 1971-1972 and 1999-2004. *Arch Ophthalmol*. 2009;127(12):1632–1639. doi:10.1001/archophthalmol.2009.303
3. Sankaridurg P, Tahhan N, Kandel H, et al. IMI Impact of myopia. *Invest Ophthalmol Vis Sci*. 2021;62(5):2. doi:10.1167/iovs.62.5.2

4. Holden BA, Fricke TR, Wilson DA, et al. Global prevalence of myopia and high myopia and temporal trends from 2000 through 2050. *Ophthalmology*. 2016;123(5):1036–1042. doi:10.1016/j.ophtha.2016.01.006
5. You QS, Wu LJ, Duan JL, et al. Factors associated with myopia in school children in China: the Beijing childhood eye study. *PLoS One*. 2012;7 (12):e52668. doi:10.1371/journal.pone.0052668
6. Pan C-W, Dirani M, Cheng C-Y, et al. The age-specific prevalence of myopia in Asia: a meta-analysis. *Optometry Vision Sci*. 2015;92(3):258–266. doi:10.1097/OPX.0000000000000516
7. Matsumura S, Ching-Yu C, Saw S-M. *Global Epidemiology of Myopia*. Singapore: Springer; 2020:27–51.
8. Pan CW, Ramamurthy D, Saw SM. Worldwide prevalence and risk factors for myopia. *Ophthalmic Physiological Optics*. 2012;32(1):3–16. doi:10.1111/j.1475-1313.2011.00884.x
9. Holden BA, Fricke TR, Wilson DA, et al. Global prevalence of myopia and high myopia and temporal trends from 2000 through 2050. *Ophthalmology*. 2016;123(5):1036–1042.
10. Flitcroft D. The complex interactions of retinal, optical and environmental factors in myopia aetiology. *Prog Retin Eye Res*. 2012;31(6):622–660. doi:10.1016/j.preteyeres.2012.06.004
11. Tideman JWL, Snabel MCC, Tedja MS, et al. Association of axial length with risk of uncorrectable visual impairment for Europeans with myopia. *JAMA Ophthalmol*. 2016;134(12):1355–1363. doi:10.1001/jamaophthalmol.2016.4009
12. Morgan IG, Ohno-Matsui K, Saw SM. Myopia. *Lancet*. 2012;379(9827):1739–1748. doi:10.1016/S0140-6736(12)60272-4
13. Naidoo KS, Fricke TR, Frick KD, et al. Potential lost productivity resulting from the global burden of myopia: systematic review, meta-analysis, and modeling. *Ophthalmology*. 2019;126(3):338–346. doi:10.1016/j.ophtha.2018.10.029
14. Belete GT, Anbesse DH, Tsegaye AT, Hussen MS. Prevalence and associated factors of myopia among high school students in Gondar town, northwest Ethiopia, 2016. *Clinical Optometry*. 2017;9:11. doi:10.2147/OPTO.S120485
15. Rose K, Harper R, Tromans C, et al. Quality of life in myopia. *Br j Ophthalmol*. 2000;84(9):1031–1034. doi:10.1136/bjo.84.9.1031
16. Pokharel GP, Negrel AD, Munoz SR, et al. Refractive error study in children: results from Mechi Zone, Nepal. *Am J Ophthalmol*. 2000;129 (4):436–444. doi:10.1016/S0002-9394(99)00453-5
17. Jacobsen N, Jensen H, Goldschmidt E. Does the level of physical activity in university students influence development and progression of myopia? —a 2-year prospective cohort study. *Invest Ophthalmol Vis Sci*. 2008;49(4):1322–1327. doi:10.1167/iovs.07-1144
18. Kinge B, Midelfart A. Refractive changes among Norwegian university students-A three-year longitudinal study. *Acta Ophthalmologica Scandinavica*. 1999;77(3):302–305. doi:10.1034/j.1600-0420.1999.770311.x
19. Sun J, Zhou J, Zhao P, et al. High prevalence of myopia and high myopia in 5060 Chinese university students in Shanghai. *Invest Ophthalmol Vis Sci*. 2012;53(12):7504–7509. doi:10.1167/iovs.11-8343
20. Saw S-M, Matsumura S, Hoang QV. Prevention and management of myopia and myopic pathology. *Invest Ophthalmol Vis Sci*. 2019;60 (2):488–499. doi:10.1167/iovs.18-25221
21. Al–Rashidi SH, Albahouth AA, Althwini WA, et al. Prevalence refractive errors among Medical Students of Qassim University, Saudi Arabia: cross-sectional descriptive study. *Open Access Macedonian j Med Sci*. 2018;6(5):940. doi:10.3889/oamjms.2018.197
22. Assem AS, Tegegne MM, Fekadu SA. Prevalence and associated factors of myopia among school children in Bahir Dar city, Northwest Ethiopia, 2019. *PLoS One*. 2021;16(3):e0248936. doi:10.1371/journal.pone.0248936
23. Chaudhry R, Ali H, Sheikh NH. Frequency and underlying factors of myopia among medical students. *Biomedica*. 2011;27(2):154–160.
24. Patel K. Prevalence of refractive errors and determinants of myopia among students in GMERS Medical College, Patan, Gujarat, India. *Nat J Physiol Pharm Pharmacol*. 2019;9(7):652–656.
25. Moafa MAM. Quantifying Risk Factors for Myopia: instrument Validation and Establishing Dosage for Light Intensity and Duration. 2018.
26. Wang L, Du M, Yi H, et al. Prevalence of and Factors Associated with Myopia in Inner Mongolia Medical Students in China, a cross-sectional study. *BMC Ophthalmol*. 2017;17(1):1–7. doi:10.1186/s12886-017-0446-y
27. Hagen LA, Gjelle JV, Arnegard S, et al. Prevalence and possible factors of myopia in Norwegian adolescents. *Sci Rep*. 2018;8(1):1–10. doi:10.1038/s41598-018-31790-y
28. Khader Y, Batayha W, Abdul Aziz S, Al Shiekh Khalil M. Prevalence and risk indicators of myopia among schoolchildren in Amman, Jordan. *EMHJ*. 2006;12(3–4):434–439.
29. Gessesse SA, Teshome AW. Prevalence of myopia among secondary school students in Welkite town: south-Western Ethiopia. *BMC Ophthalmol*. 2020;20(1):1–6. doi:10.1186/s12886-020-01457-2
30. Atowa UC, Wajuihian SO, Munsamy AJ. Prevalence and risk factors for myopia among school children in Aba, Nigeria. *African Vision Eye Health*. 2017;76(1):1–5. doi:10.4102/aveh.v76i1.369
31. Wajuihian SO, Hansraj R. Refractive error in a sample of black high school children in South Africa. *Optometry Vision Sci*. 2017;94 (12):1145–1152. doi:10.1097/OPX.0000000000001145
32. Megbelayin EO, Asana UE, Nkanga DG, et al. Refractive errors and spectacle use behavior among medical students in a Nigerian medical school. *J Adv Med Med Res*. 2014;4(13):2581–2589. doi:10.9734/BJMMR/2014/7518
33. Algorinees R, Alqahtani N, Aljarbou A, AlShammari R, Alrashidi A. Prevalence of myopia and its related risk factors among medical students in Saudi Arabia. *Adv Ophthalmol Vis Syst*. 2017;6(1):00165.
34. Hashemi H, Derakhshan A, Mousavi MN, Mohazzab-Torabi S. The prevalence of refractive errors among Iranian university students. *J Curr Ophthalmol*. 2014;26(3):129.
35. Woo W, Lim K, Yang H, et al. Refractive errors in medical students in Singapore. *Singapore Med J*. 2004;45:470–474.
36. Lv L, Zhang Z. Pattern of myopia progression in Chinese medical students: a two-year follow-up study. *Graefe's Arch Clin Exp Ophthalmol*. 2013;251(1):163–168. doi:10.1007/s00417-012-2074-9
37. Wakode N, Wakode S, Ksheersagar D. Risk factors for myopia in medical students. *Int J Recent Trends Sci Technol*. 2013;8(1):09–11.
38. Mehta R, Bedi N, Punjabi S. Prevalence of myopia in medical students. *Indian J Clin Exp Ophthalmol*. 2019;5(3):322–325. doi:10.18231/j.ijceo.2019.077
39. Paudel P, Ramson P, Naduvilath T, et al. Prevalence of vision impairment and refractive error in school children in B a R ia–V ung T au province, V ietnam. *Clin Experiment Ophthalmol*. 2014;42(3):217–226. doi:10.1111/ceo.12273

40. Verhoeven VJ, Buitendijk GH, Rivadeneira F, et al. Education influences the role of genetics in myopia. *Eur J Epidemiol*. 2013;28(12):973–980. doi:10.1007/s10654-013-9856-1
41. Ahn H, Lyu IS, Rim TH. The influence of parental myopia on children's myopia in different generations of parent-offspring pairs in South Korea. Seminars in ophthalmology; 2018 Taylor & Francis.
42. Tsai T-H, Liu Y-L, Ma I-H, et al. Evolution of the prevalence of myopia among Taiwanese schoolchildren: a review of survey data from 1983 through 2017. *Ophthalmology*. 2021;128(2):290–301. doi:10.1016/j.ophtha.2020.07.017
43. Chen X, Ye G, Zhong Y, et al. Prevalence, incidence and risk factors for myopia among urban and rural children in southern China: protocol for a school-based cohort study. *medRxiv*. 2021.
44. Jan C, Li L, Keay L, Stafford RS, Congdon N, Morgan I. Prevention of myopia, China. *Bull World Health Organ*. 2020;98(6):435. doi:10.2471/BLT.19.240903
45. Kung Y-J, Wei -C-C, Chen LA, et al. Kawasaki disease increases the incidence of myopia. *Biomed Res Int*. 2017;2017:554.
46. Shapira Y, Mimouni M, Machluf Y, et al. The increasing burden of myopia in Israel among young adults over a generation: analysis of predisposing factors. *Ophthalmology*. 2019;126(12):1617–1626. doi:10.1016/j.ophtha.2019.06.025
47. Parveen N, Hassan SH, Rehman J, Shoukat U. Prevalence of myopia and its associated risk factors in local medical students. *Cell*. 2015;334:3887822.
48. Vaidya CV, Majmudar DK. A retrospective study of clinical profile of stroke patients from GMERS medical college and hospital, Gandhinagar, Gujarat. *Int J Clin Trials*. 2014;1(2):62–66. doi:10.5455/2349-3259.ijct20140805
49. Morgan IG, Ohno-Matsui K, Saw S-M. Myopia. *Lancet*. 2012;379(9827):1739–1748.
50. Wong Y-L, Saw S-M. Epidemiology of pathologic myopia in Asia and worldwide. *Asia Pacific J Ophthalmol*. 2016;5(6):394–402. doi:10.1097/APO.0000000000000234
51. Zhang X, Qu X, Zhou X. Association between parental myopia and the risk of myopia in a child. *Exp Ther Med*. 2015;9(6):2420–2428. doi:10.3892/etm.2015.2415
52. Ang M, Wong TY. *Updates on Myopia: A Clinical Perspective*. Springer Nature; 2020.
53. Chalasani S, Jampala VK, Nayak P. Myopia among medical students-A cross sectional study in a South Indian medical college. *Al Ameen J Med Sci*. 2012;5(3):233–242.
54. Khan AR, Ali B, Khan B, et al. Refractive Errors among Medical Students–A Cross-sectional Study. *Int J Sci Study*. 2021;8(10):23–29.
55. Onal S, Toker E, Akingol Z, et al. Refractive errors of medical students in Turkey: one year follow-up of refraction and biometry. *Optometry Vision Sci*. 2007;84(3):175–180. doi:10.1097/OPX.0b013e3180335c52
56. Midelfart A, Aamo B, Sjøhaug KA, Dysthe BE. Myopia among medical students in Norway. *Acta Ophthalmol*. 1992;70(3):317–322. doi:10.1111/j.1755-3768.1992.tb08571.x
57. Huang L, Kawasaki H, Liu Y, Wang Z. The prevalence of myopia and the factors associated with it among university students in Nanjing: a cross-sectional study. *Medicine*. 2019;98:10.
58. Nanis ATA, Fatmawati NK, Yuliana Y, Sawitri E. The Differences Of Myopia Risk Factors On Medicine Student And Pyshical, Health And Recreation Education Students In Unmul Samarinda. *Jurnal Ilmu Kesehatan*. 2019;7(2):130.
59. Rose KA, Morgan IG, Ip J, et al. Outdoor activity reduces the prevalence of myopia in children. *Ophthalmology*. 2008;115(8):1279–1285. doi:10.1016/j.ophtha.2007.12.019